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### A PHYLOGENETIC STUDY OF THE GENUS TERIOCOLIAS ROEBER (LEPIDOPTERA, PIERIDÆ)

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In the course of the author's study of the genus *Eurema* it was necessary to examine the structures of related genera of the *Pieridæ*. *Teriocolias* then consisted of but one species, *atinas* Hewitson, which, previous to the erection of the genus *Teriocolias* by Roeber, had been considered as belonging to *Eurema*. Naturally all possible data on this were examined. At the present time, in view of the description of a new *Teriocolias*, *andina*, by Dr. Forbes, it seems advisable to publish these data on the structures of the two species, and the conclusions drawn from a study of these regarding the probable origin of the genus.

Genitally *atinas* and *andina* are very similar to each other, and are more closely related to *Eurema* than are any other New World forms, with the possible exception of *Leucidia*. It should be stated that in the present article "*Eurema*" refers solely to the New World species of the genus, as the Old World forms are quite different. The male genitalia of *atinas* and *andina*, Figures 1 and 2, fail, however, to show any decided enough characters to enable one to determine, by this means alone, to just what species of *Eurema* the relationship is most close.

In order to make clear this relationship it seems advisable to give an outline of the author's theory of the development of the

*Eurema* genitalia. For a more comprehensive description reference should be made to the author's article on the subject. See Figures 1, 2 and 5. Lobe *a* is considered as representing a modified form of the clasper, and as having arisen, in all probability, as an evagination from the valve in its present position. The other lobes are believed to arise from the distal process and when formed to migrate down onto the body of the valve. The greatest number of lobes found in any species of *Eurema* or any related genus is five, on the valve of *E. nise*. These lobes were accordingly designated by the letters *a*, *b*, *c*, *d* and *e*. The last four originate on the distal process in the probable order *e*, *b*, *d*, *c*, or *e*, *d*, *b*, *c*.

In the hind wing of *andina* (Fig. 4),  $R_s$  and  $M_1$  are well stalked. This characteristic occurs on but one line of development in *Eurema*, on which line *nicippe* Cramer represents a primitive form; *graduata* Butler and a number of related species are intermediate, and *salome* Felder and *mexicana* Boisduval show the highest development. In *nicippe* this stalking is very incompletely shown, while in the genitalia lobes *b* and *e* are well developed, lobe *a* is very small, and lobe *c* is absent with the distal process showing no trace of its development. *Graduata* and its kindred species show a higher development approximating that of *andina* both in venation and genitalia; in the latter lobe *d* being formed but still on the distal process, while *arbela* and *mexicana* are the most highly developed in the line, with lobe *d* fully formed and moved down onto the valve, leaving the distal process simple as before.

In the matter of the stalking of  $R_s$  and  $M_1$ , *andina* has progressed farther than *atinas*. On the primary, however, the stalking of  $R_2$  on  $R_{3+4+5} + M_1$  has progressed farther in *atinas* than in *andina*. Genitally *atinas* is the better developed, as it not only has lobe *d* slightly better developed on the distal process but also a specialized process on the dorsal margin of the valve (Fig. 1, "dorsal process"), which is absent or only slightly indicated in *andina*.

This "dorsal process" also occurs in *Eurema deva* Doubleday but, inasmuch as *deva* is on a line which is characterized by the failure of lobe *b* to develop, the similarity must be regarded as

merely analogous. Another species of *Eurema*, *amelia* Poey, shows the staking of  $R_2$  on  $R_{3+4+5} + M_1$  which is a *Teriocolias* characteristic; *amelia*, moreover, shares with *Eurema proterpia* Fabricius the extreme shortness or absence of the middle discocellular of the secondary which is also possessed by *Teriocolias*. I do not think that *amelia* can, however, be regarded as a *Teriocolias*, although I am not satisfied with its position in *Eurema*. It does not seem to warrant the erection of a new genus, but is still a distinctly different species, possessing marked affinities to both *Eurema* and *Teriocolias*, but not positively a member of either.

The conclusions reached are:

(1) *Andina* and *atinas* show an almost equal development in venation, but *atinas* is slightly the more highly developed genitally.

(2) The line of development of *Teriocolias*, characterized by the scaling of the antennæ, the characteristic wing shape and pattern, the absence of the upper and the absence or extreme shortness of the middle discocellulars in the secondary, and the staking of  $R_2$  on  $R_{3+4+5} + M_1$ , arose from a line of development of *Eurema* that is characterized by the staking of  $R_s$  and  $M_1$ . Both species of *Teriocolias* have progressed, in characters common to the two genera, to a point about equal to *E. graduata*. Inasmuch, however, as they have developed in addition the generic characters, they must be regarded as being somewhat more highly advanced than *graduata*—just how much it is of course impossible to evaluate.

In Figure 6 I have endeavored to show this. The *Eurema* line is included, represented by a double line, while that of *Teriocolias* is single.

Following is a key for the differentiation of the two species of *Teriocolias* by structural characters:

1. Male genitalia with a conical process arising from the dorsal margin of the valve. On the primary  $R_2$  stalked on  $R_{3+4+5} + M_1$  for a distance greater by at least twice than the length of the middle discocellular. On the secondary  $R_s$  and  $M_1$  not stalked or very slightly so.....*atinas*
1. Male genitalia with no conical process arising from the dorsal margin of the valve. On the primary  $R_2$  stalked on  $R_{3+4+5} + M_1$  for a distance subequal to the length of the middle discocellular. On the secondary  $R_s$  and  $M_1$  well stalked.....*andina*

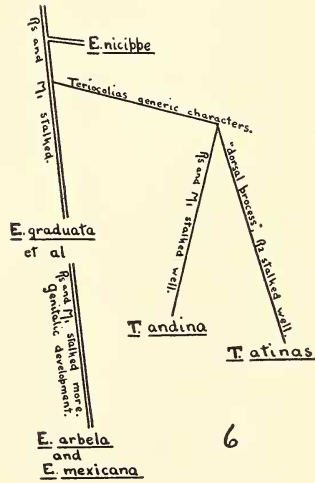
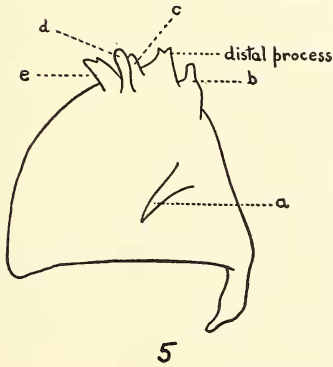
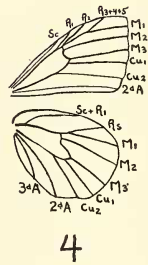
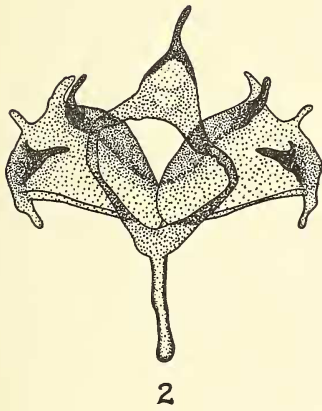
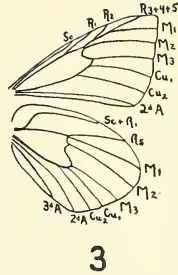
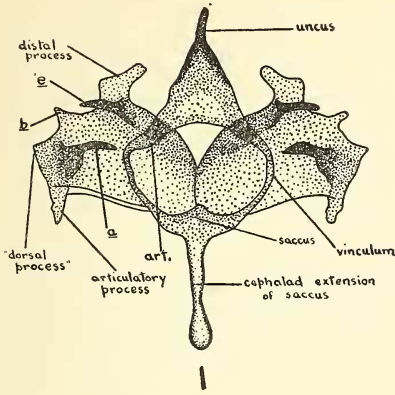
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3. *andina* Forbes, *Jour. N. Y. Ent.*, Vol. XXXVI, Mar. 1928.
4. *Eurema genitalia* Klots, *Jour. N. Y. Ent.*, Vol. XXXVI, Mar. 1928.

## PLATE V

- Figure 1. Male genitalia, *Teriocolias atinas* Hewitson; Tarma, Peru. In coll. Cornell University.
- Figure 2. Male genitalia, *Teriocolias andina* Forbes; Holotype, Peru. Henry Edwards' coll., no. 3511, in A. M. N. H.
- Figure 3. Venation, *T. atinas*, as above.
- Figure 4. Venation, *T. andina*, Holotype as above.
- Figure 5. Outline, ental aspect, left valve, *Eurema nise* Cramer.
- Figure 6. Phylogeny of *Teriocolias*.

NOTE.—The articulation of the valves has been severed, in order that they might be spread out flat. Normally the structure labelled "articulatory process," in Figure 1, is articulated to the uncus at point marked "art."



TERIOCOLIAS